Sept. 4, 1973 L. G. NETTELAND 3,756,785

GAS GENERATOR ASSEMBLY

Filed Sept. 15, 1971 4 Sheets-Sheet 1

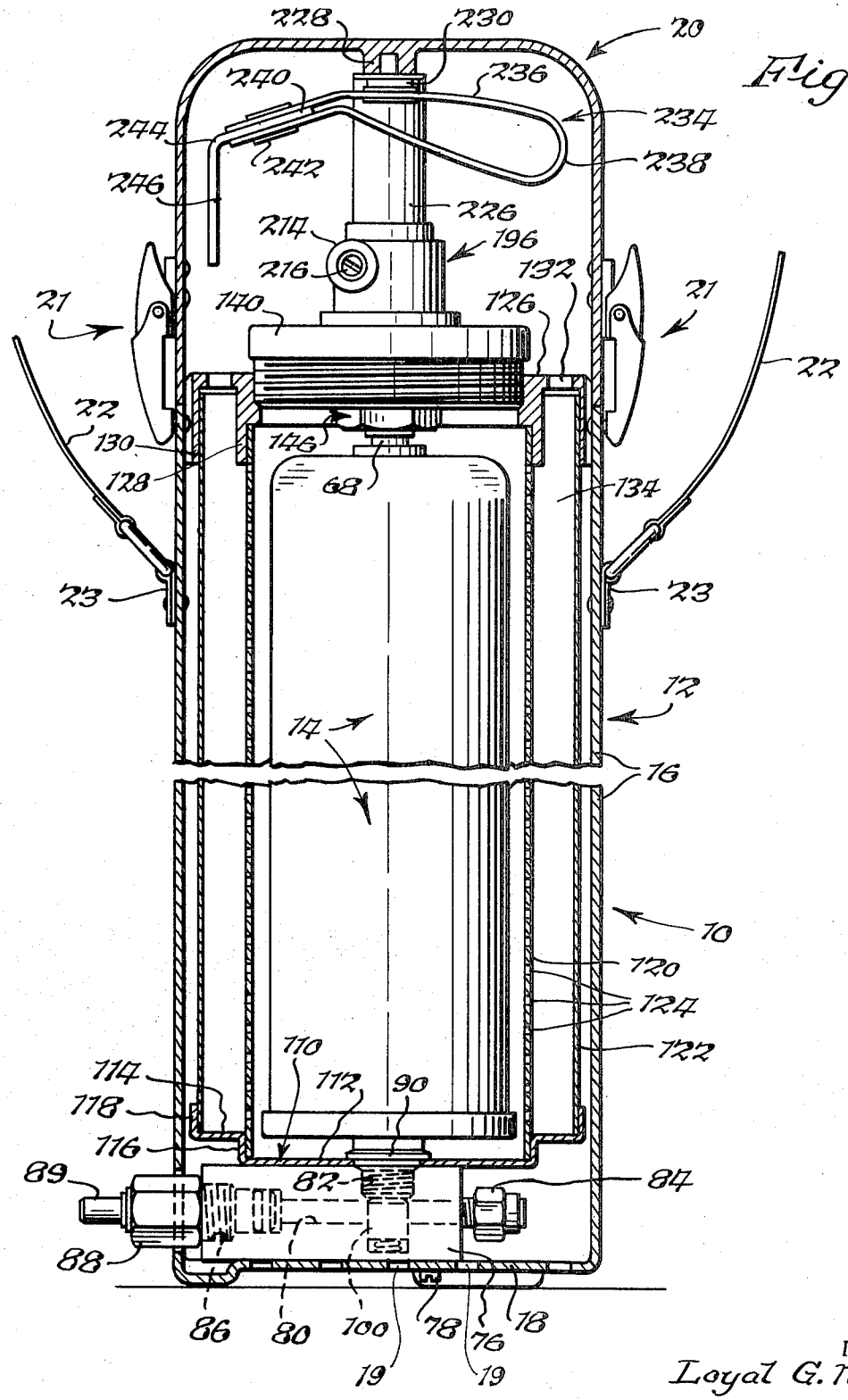

Fig. 1.

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GAS GENERATOR ASSEMBLY

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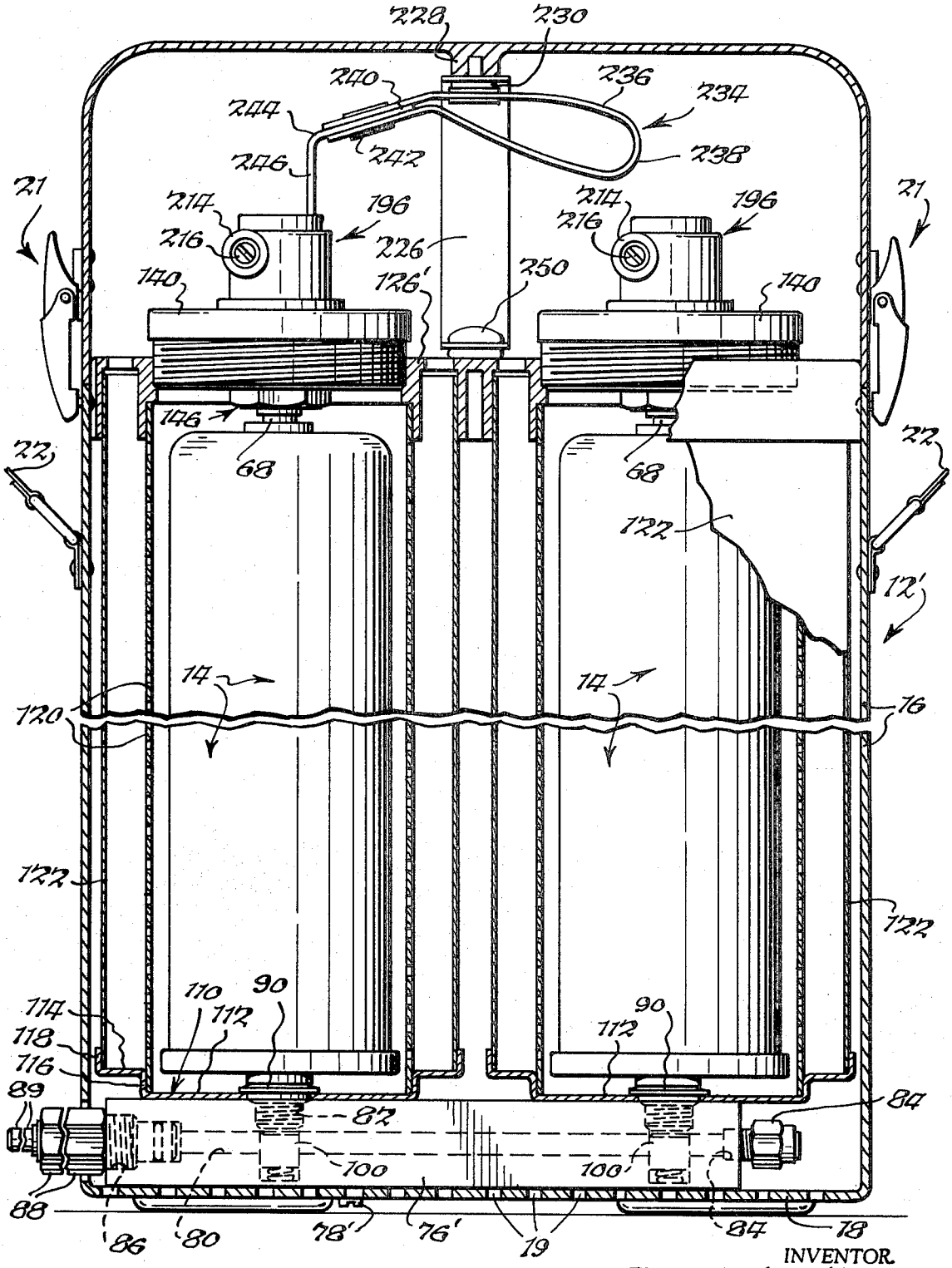

Fig. 2.

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GAS GENERATOR ASSEMBLY

Filed Sept. 15, 1971 4 Sheets-Sheet 3

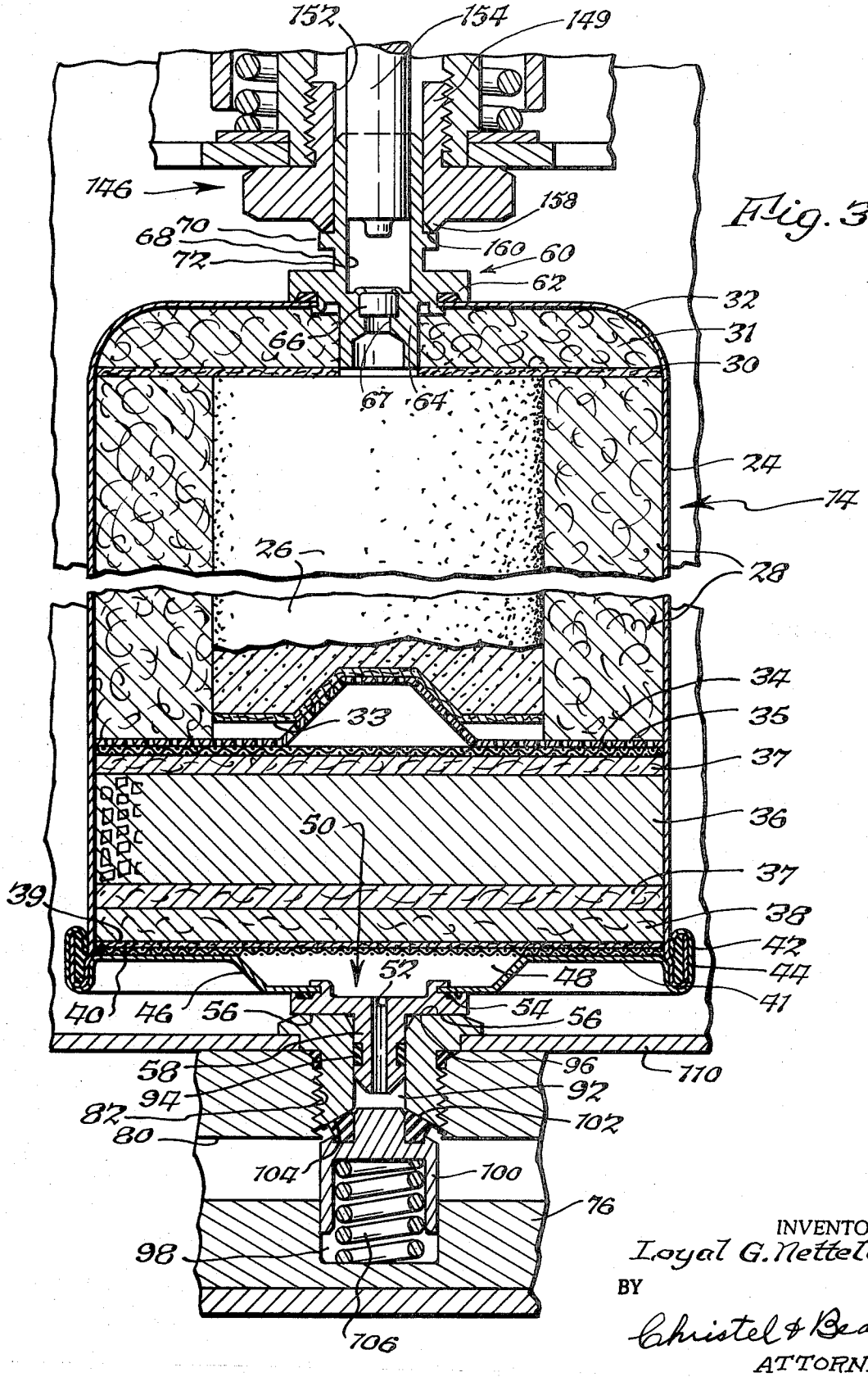

Fig. 3.

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GAS GENERATOR ASSEMBLY

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Fig. 4.

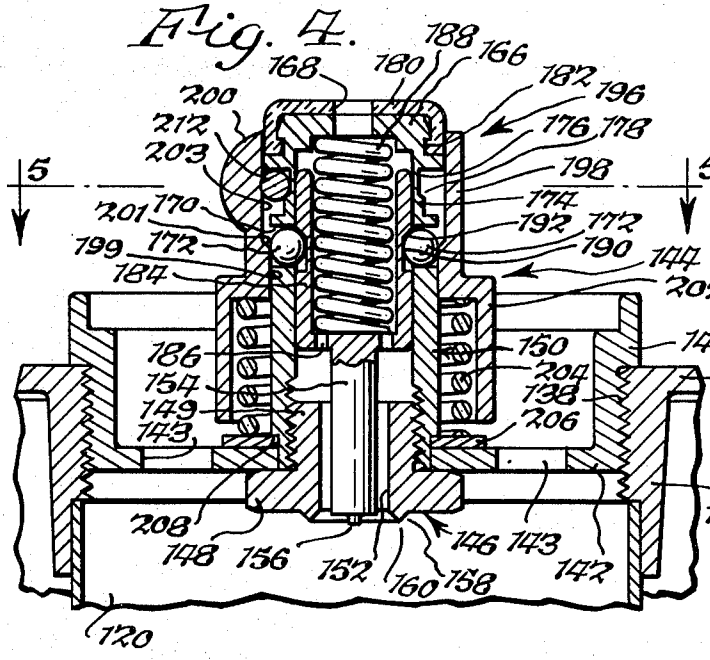


Fig. 5.

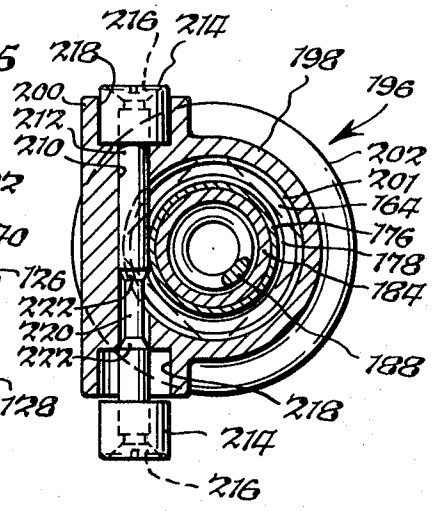


Fig. 6.

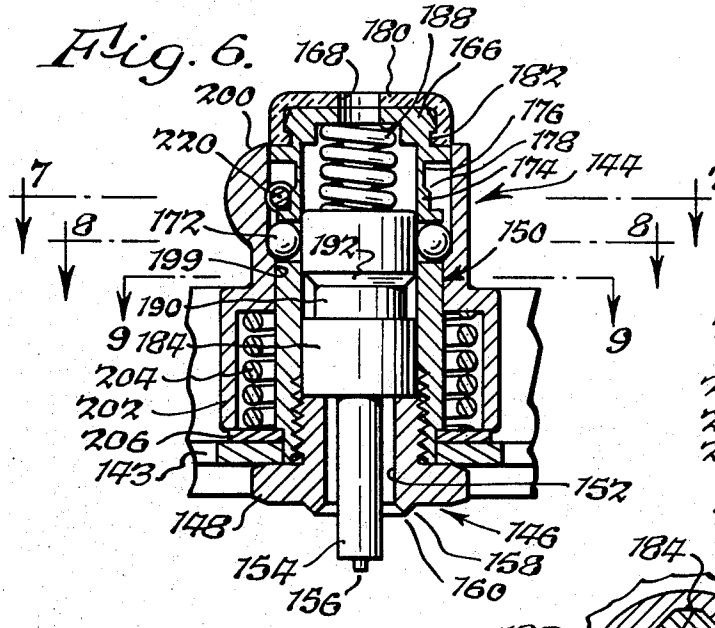


Fig. 7.

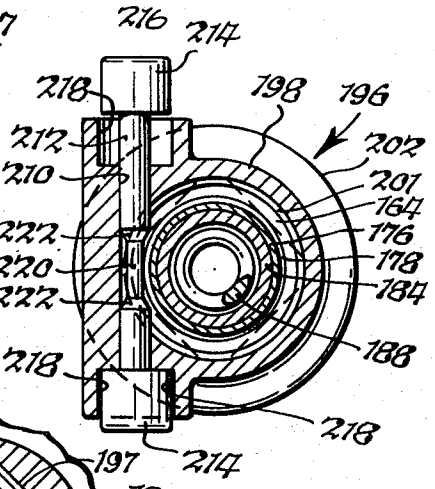
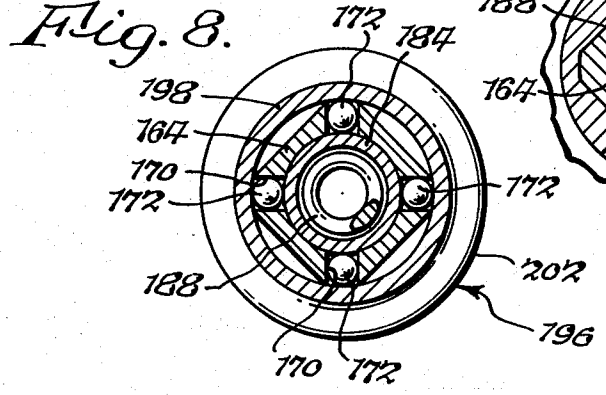


Fig. 8.



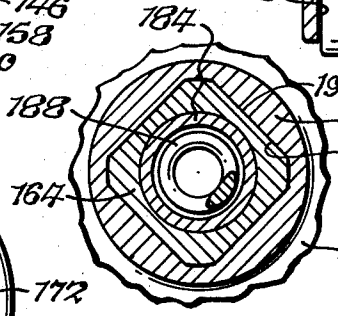


Fig. 9.

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United States Patent Office 3,756,785 Patented Sept. 4, 1973

3,756,785

GAS GENERATOR ASSEMBLY

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Filed Sept. 15, 1971, Ser. No. 180,558
Int. Cl. B01j 7/00
U.S. Cl. 23—281 16 Claims

ABSTRACT OF THE DISCLOSURE

A gas generator assembly comprising a housing containing an oxygen evolving cartridge in spaced relation to the housing. A manually operable actuating mechanism, easily reset or cocked by hand, is releasably secured in the housing in spaced relation to the cartridge for igniting the oxygen candle therein. A safety release pin locks the actuating mechanism in the cocked position to prevent inadvertent ignition of the candle.

BACKGROUND OF THE INVENTION

This invention relates to a gas generator and, more particularly, to a self contained oxygen-evolving apparatus especially adapted for regular use by patients having respiratory ailments and for respiratory and cardiac emergencies.

Gas generators comprising oxygen evolving chlorate candles mounted in cannisters or containers are known, and offer certain advantages over cylinders of oxygen under pressure. Often, these known generators employ an over-the-center type of percussion actuator, which not only is difficult to cock for repeated action, but requires locating the primer in close proximity to the actuator. Since the heat of combustion of the primer and candle is intense, the actuator and container reach excessive temperatures. While such oxygen evolving generators are very useful in many emergency situations, such as might be encountered in submerged watercraft or high flying aircraft, they present a problem when used by respiratory patients or by medical personnel who must handle such generators and trigger the actuator by hand. Also, the difficulty in manually resetting or cocking the actuator for subsequent use with a freshly replaced oxygen candle renders them unsuitable for repeated usage by respiratory patients and by medical personnel.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved solid state gas generator assembly having a novel actuator that can be easily reset for repeated usage.

It is another object of this invention to provide the foregoing gas generator assembly with an actuator arrangement facilitating an optimal design relation betwen the primer and candle body and between the generator and the operator.

It is a further object of the present invention to provide a novel solid state gas generator housing having spaced heat dissipating and heat shielding means to preclude undesirable heat transmission to the housing.

It is still another object of this invention to provide the foregoing gas generator assembly with a self contained chemical oxygen evolving unit having means affixed to the opposite ends thereof for properly orienting such unit in a spaced relation to the actuator and the associated housing.

In one aspect thereof, the gas generator assembly of the present invention is characterized by the provision of stud means affixed to the opposite ends of an oxygen evolving cartridge for spacing the latter from the ignition actuating mechanism and from the housing walls. The ignition actuating mechanism is easily operated and reset by hand and

is provided with a locking mechanism to prevent inadvertent firing. An inner heat dissipating linear and an outer heat shield spaced therefrom are interposed between the oxygen evolving cartridge and the housing.

The foregoing and other objects, advantages and characterizing features of the present invention will become clearly apparent from the ensuing detailed description of an illustrative embodiment thereof, taken together with the accompanying drawing wherein like reference numerals denote like parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal sectional view of one form of a gas generating assembly of the present invention;

FIG. 2 is a longitudinal sectional view of another form of gas generating assembly of this invention;

FIG. 3 is a fragmentary vertical sectional view, on an enlarged scale, showing the oxygen evolving unit and a portion of the ignition mechanism therefor;

FIG. 4 is a fragmentary vertical sectional view, on an enlarged scale, showing details of the ignition actuating mechanism in its locked, cocked position;

FIG. 5 is a transverse cross sectional view taken about on line 5—5 of FIG. 4;

FIG. 6 is a view similar to FIG. 4, showing the ignition actuating mechanism in its released, firing position;

FIG. 7 is a transverse cross sectional view taken about on line 7—7 of FIG. 6;

FIG. 8 is a transverse cross sectional view taken about on line 8—8 of FIG. 6; and

FIG. 9 is a transverse cross sectional view taken about on line 9—9 of FIG. 6.

DETAILED DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

Referring now in detail to the drawings, there is shown in FIG. 1 an illustrative embodiment of an oxygen generator assembly, generally designated **10**, constructed in accordance with this invention, comprising a housing **12** for enclosing an oxygen generator cartridge **14**. Housing **12** is of a generally cylindrical configuration and comprises a cylindrical tubular shell **16**, a bottom end wall **18** having perforations **19** therethrough, and a top end cover **20**. Cover **20** is releasably secured to shell **16** by any suitable means, such as a pair of conventional toggle-type safety locks **21** for example. A strap **22** is connected to shell **16** by means of suitable fasteners **23** and is adapted to be looped over the head and about the neck of the user for supporting generator **10** preferably adjacent one side of the user in the area of the hip region. The terms top, bottom, upper, lower and the like are used for convenience of description with reference to the drawings and are not used in a limiting sense.

As shown in FIG. 3, oxygen generating cartridge **14** comprises a cannister **24** encasing an inner body composition capable of evolving oxygen upon burning. By way of example, the composition can consist of a consolidated core body, hereinafter referred to as an oxygen candle **26**, having uniformly distributed therethrough an alkali metal chlorate or perchlorate which generates oxygen, a finely divided oxidizable material such as iron powder for burning and supplying part of the heat needed for release of oxygen through an exothermic reaction, a binder such as inorganic glass fibers or steel wool for holding the mass together and aiding in the even decomposition of the chlorate or perchlorate, and barium peroxide or like chlorine fixes for chemically eliminating traces of chlorine gas released during thermal breakdown of the chlorate or perchlorate. Such oxygen candle compositions are known and, per se, form no part of the present invention. The body of oxygen candle **26** can be press-molded or cast to form a cylinder having an ignition area located cen-

trally at the upper end thereof, such ignition area comprising the foregoing composition enriched with a metal powder, such as iron, to provide a concentrated area of intense heat when ignited.

Candle body **26** is encased within a heat insulating envelope **28** of filter medium interposed between candle body **26** and cannister **24** to insulate the latter from the heat of combustion. Envelope **28** can be formed of fiberglass and, if desired, impregnated with a silicate or other hardening agent in an amount sufficient to make the envelope shape sustaining in the desired form. In the illustrative embodiment depicted in FIG. 3, an annular pad **30** is mounted on top of candle **26** and envelope **28** in spaced relation to the top end wall **32** of cannister **24**. A fiberchrome filter **31** is interposed between pad **30** and cannister top end wall **32**. The bottom end of candle **26** is provided with a fiberfrax disc **33** having an inwardly dished portion resting on the complementary inwardly dished portion of a perforated baffle plate **34** supported on a metallic screen **35**. A layer of catalyst **36**, such as the well known Hopcalite, is sandwiched between a pair of fiberfrax discs **37** beneath oxygen candle **26** and is effective to oxidize to carbon dioxide any carbon monoxide that may result from the combustion of oxygen candle **26**. The lower disc **37** is supported on a micro quartz pad **38** which, in turn, is supported on a fiberglass pad **39** resting on a metallic screen **40**. Screen **40** rests against the inner surface of a cannister cover or bottom end wall **41**, which is provided with an inturned, curved flange **42** at the marginal edge thereof rolled into sealing relation with an annular bead **44** forming a continuation of the cannister body and located at the bottom end thereof. Thus, in forming cartridge **14**, the foregoing components are inserted through the bottom open end of cannister **24** and then sealed by cover **41**.

Bottom end wall **41** is formed with an outwardly dished portion **46** defining a chamber **48** into which filtered oxygen is collected. A stud, generally designated **50** and having a bore **52** therein, is suitably attached to portion **46** of bottom wall **41** and is maintained in a gas tight relation therewith by means of a suitable seal **54**. Stud **50** is provided with an annular abutment shoulder **56** and a tubular body **58** adapted to be received in a manifold coupling as will hereinafter become apparent.

Mounted on upper end wall **32** of cannister **24** in a gas tight relation therewith is a stud **60** having a flange **62** and a cylindrical body **64** extending downwardly from flange **62** to pad **30**, which is provided with a central opening communicating with candle **26**. A primer **66** is mounted within body **64** and communicates with the ignition area of oxygen candle **26** through a bore **67** provided in body **64**. Stud **60** also includes a tubular body portion **68** extending upwardly from flange **62** and having an annular flange **70** spaced from flange **62**. Body portion **68** is adapted to be received in a retainer forming part of the primer actuating mechanism and is bored as at **72** to receive a firing pin, hereinafter more fully described. The oxygen generating cartridge **14** thus far described includes studs **50** and **60** and constitutes a disposable, self-contained unit which, when spent, can be replaced by a fresh unit in housing **12**.

A manifold **76** is suitably secured to bottom end wall **18** of housing **12** (FIG. 1) as by means of screws **78** and is provided with a longitudinal passage **80** communicating with a tapped opening **82**. One end of passage **80** leads to a port having a pressure relief valve **84** suitably threaded therein. The other end of passage **80** leads to a port **86** connected to a coupling **88** having a hose fitting **89** for connection to a flexible delivery tube (not shown) connected at its other end to the usual face mask, also not shown. The mask, delivery tube and a fitting connection when not in use, can be stored within cover **20**. A fitting **90** is threaded into tapped opening **82** in a gas tight relation therewith and is provided with a bore **92** for receiving tubular body **58** of stud **50**. A seal **94** is disposed in a peripheral groove formed in body **58** to provide pressure sealing between body **58** and fitting **90**. Fitting **90** is provided with an outer face **96** which serves as a seating surface for shoulder **56** of stud **50**.

A cavity **98** is formed in manifold **76** in registry with opening **82** for receiving a check valve **100** therein. Check valve **100** is provided with a beveled resilient sealing surface **102** adapted to engage a beveled valve seat **104** formed on the end of fitting **90**. Valve **100** is normally biased against valve seat **104** by means of a helical spring **106** disposed between the rear face of valve **100** and the bottom of cavity **98**. The filtered oxygen under pressure generated by the combustion of candle **26** flows from chamber **48** through bore **52** of stud **50** and acts against valve **100** to urge the latter away from its seat **104**, allowing the oxygen to flow through opening **82**, passage **80**, port **86**, coupling **88** and ultimately to the user. Excess pressures are dissipated through relief valve **84** in the usual manner.

A support plate **110** is mounted within the lower end of housing **12** (FIG. 1) between manifold **76** and a stepped flange on fitting **90**. Plate **110** has a generally circular planar portion **112** and an offset ledge **114** connected to portion **112** by an annular shoulder **116** and terminating in an annular flange **118**. Plate **110** supports the lower ends of a pair of concentric, cylindrical liners **120** and **122** the inner lines **120** being mounted in spaced relation to cartridge **14** and perforated as at **124** for dissipating the heat generated by the combustion of candle **26**. The lower end of liner **120** is supported on the planar portion **112** of plate **110** against shoulder **116**. Outer liner **122**, which serves as a heat shield, is spaced radially from liner **120** and is supported at its lower end on ledge **114** against flange **118**. The upper ends of liners **120** and **122** are supported in spaced relation by means of a retainer member **126** bonded or otherwise fixedly secured to the upper end of housing shell **16**. Member **126** has spaced cylindrical partitions **128** and **130** for embracing the upper ends of liners **120** and **122**. A plurality of passages **132** are provided in member **126** and connect an annular passage **134** defined between liners **120** and **122** to the ambient atmosphere when cover **20** is removed from shell **16**. Heat is dissipated during combustion of candle **26** by convection through the perforated liner **120** and upwardly through passages **134** and **132** to the ambient atmosphere. Liner **122** serves as a heat shield retaining the heat within passage **134** and preventing the transmission of heat to housing **12** thereby protecting the user against burning contact with housing **12**. Member **126** is provided with a central tapped opening **138** for receiving a cup-shaped casing **140** threadably secured therein and provided with a bottom wall **142** for supporting an ignition actuating assembly, generally designated **144** (FIG. 4). Bottom wall **142** is provided with a plurality of openings **143** connecting the area within liner **120** with the ambient atmosphere to aid in the dissipation of heat generated by candle **26** during combustion.

As best shown in FIGS. 4–8, actuating assembly **144** comprises a retainer **146** having a flange **18** engaging against the underside of bottom wall **142** and a body portion **149** threadably secured to an actuator **150**. Retainer **146** has a bore **152** therein for receiving the upper portion of tubular body **68** of stud **60** (FIG. 3) and a firing pin **154** having an axial projection **156** adapted to strike primer **66** for firing the latter. Flange **148** is provided with an annular rib **158** of generally triangular cross section having an annular apex portion **160** adapted to seat against stud flange **70** (FIG. 3) of cartridge **14** for properly locating the parts in the assembled relation. The entire actuating assembly **144** is assembled as a unit to cartridge **14** by inserting the upper end of stud **60** into bore **152** of retainer **146** and then threading casing **140** into opening **138** of member **126** until rib **158** seats against flange **70**. Bore **72** of stud **60** is coaxially aligned

with bore 152 of retainer 146 for receiving the end portion of firing pin 154 in the assembled relation with the upper portion of tubular body 68 interposed between retainer 146 and firing pin 154.

Actuator 150 comprises a generally cyclindrical body 164 having an end wall 166 provided with a central opening 168 therein. Body 164 is provided with four circumferentially spaced openings 170 for receiving balls 172 as shown in FIG. 8. Of course, more or less than four openings 170 and a corresponding number of balls 172 can be provided, as desired. Body 164 is provided with a reduced diameter portion 174 and a further reduced diameter portion 176 separated by a beveled shoulder 178 for a purpose hereinafter explained. An insulator cap 180 is mounted on the upper end of body 164 about end wall 166 and is provided with an annular bead 182 received in a peripheral groove formed in body 164.

Firing pin 154 is provided with a cup-shaped member 184 formed integral therewith and telescopically received within actuator body 164. Member 184 is provided with openings 186 adjacent firing pin 154 to permit the heat of candle 26 to escape by convection. A compression spring 188 is mounted within member 184 for biasing firing pin 154 toward primer 66. Member 184 is provided with a peripheral groove 190 having a beveled cam surface 192 extending from groove 190 to the outer peripheral surface of member 184. Groove 190 receives portions of balls 172 when aligned with openings 170 of actuator 150 as shown in FIG. 4 and cam surface 192 aids in ejecting balls 172 out of groove 190 upon downward movement of member 184 relative to actuator 150.

An actuator sleeve 196 is mounted about actuator 150 for sliding movement relative thereto and comprises a hollow body 198 having an inner wall surface 199 and formed with an elongated enlargement 200 (FIG. 5) at one side thereof extending generally normal to the axis body 198. As shown in FIG. 9, a portion of the inner wall surface of body 198 is flat sided as at 195 and complementary to a flat sided portion 197 of actuator body 164 to prevent relative rotation therebetween. Thus, bodies 164 and 198 can move axially relative to each other but are keyed against relative rotational movement. The inner wall surface 199 of the upper portion of sleeve body 198 is provided with an annular beveled shoulder or cam surface 201 leading to an enlarged inside diameter portion 203. The lower portion of body 198 is provided with an enlarged cup-shaped configuration having a cylindrical wall 202 radially spaced from actuator body 164 for receiving a compression spring 204 therein. The lower end of spring 204 abuts against a washer 206 supported between casing bottom wall 142 and an annular shoulder 208 provided adjacent the lower end of actuator body 164.

Enlargement 200 is provided with axially aligned bores 210 for receiving an elongated safety lock shaft 212, the central portion of which passes between portion 203 of sleeve body 198 and portions of the outer peripheral surface of actuator body 164. Enlarged heads 214 are secured to the opposite ends of shaft 212 as by means of suitable fasteners 216. These heads 214 are adapted to be received in cavities 218 provided at the opposite ends of enlargement 200. Shaft 212 is provided with an intermediate reduced diameter portion 220 having annular, bevelled shoulders or cam surfaces 222 leading to the outer peripheral surface of shaft 212. Shaft 212 is adapted to be shifted axially into a locked position as shown in FIGS. 4 and 5 whereby actuator sleeve 196 and actuator body 164 are keyed together and into a release position as shown in FIG. 7 whereby sleeve 196 can be moved vertically relative to actuator body 164.

Prior to use, the various components of actuating assembly 144 are in the relative positions shown in FIGS. 4 and 5 with safety lock shaft 212 captively held between portion 203 of actuator sleeve 196 and the reduced diameter portion 176 of actuator body 164. Thus, actuator sleeve 196 and body 164 are keyed together preventing relative sliding movement therebetween. Also, balls 172 are captively disposed in openings 170 of actuator body 164 and partially in peripheral groove 190 of member 184. In this position, balls 172 lock member 184 upwardly against the bias of spring 188, thus maintaining firing pin 154 upwardly within bore 152 in a cocked position.

In use, strap 22 is placed about the user's neck region in a manner supporting generator 10 along one side of the user and the toggle-type safety locks 21 are released. Cover 20 can then be removed from housing 12 and the breathing mask and delivery tube removed and connected to the coupling 89. The breathing mask is not placed about the user's mouth until the oxygen generator is actuated and the oxygen evolving process initiated. Cover 20 is left dangling from generator 10 by means of a tether strap 226 connected at one end thereof to a central boss 228 in end cover 20 by a fastener 230 (FIG. 1) and connected at the other end to member 126 by any suitable means (not shown). Thus, although cover 20 is removed from housing 12 to expose actuating assembly 144, it remains attached thereto by strap 226 so as to prevent misplacement thereof.

The user then shifts safety lock shaft 212 axially to position the reduced diameter portion 220 between portion 203 of actuator sleeve 196 and portion 176 of actuator body 164 to permit actuation of assembly 144. To initiate the oxygen evolving process, actuator sleeve 196 is slid downwardly relative to body 164 against the bias of spring 104 to the position shown in FIG. 6. This relative movement can be effected due to the reduced diameter portion 220 of shaft 212 which readily fits into the space between portion 203 of sleeve 196 and portion 174 of body 164.

Upon relative sliding movement between sleeve 196 and body 164, the larger inside diameter portion 203 of sleeve 196 provides a wider space for receiving balls 172 which are cammed radially outwardly from grooves 190 by cam surface 192 under the influence of spring 188. Member 184 is thereby released allowing the force of spring 188 compressed therein to drive firing pn 154 downwardly into contact with primer 66 for igniting the latter and initiating ignition of oxygen candle 26. When firing pin 154 is released, the various components of actuating assembly 144 are in the relative positions shown in FIG. 6. The evolved oxygen passes through chamber 48, bore 52 of stud 50 and bore 92 of fitting 90. The pressure of the evolved oxygen builds up and acts against the face of check valve 100 until such pressure overcomes the bias of spring 106 to unseat valve 100. The oxygen escapes past check valve 100, through passage 80, port 86, coupling 88, hose fitting 89 and the delivery tube to the face mask at a rate sufficient to meet the oxygen consumption of the user. Excess pressures are relieved through valve 84.

The heat generated by the combustion of oxygen candle 26 is dissipated by convection through perforated liner 120, passages 134, 132 and outwardly through the open end of housing 12 into the ambient atmosphere. Perforations 19 in bottom end wall 18 permit cool air to communicate with the interior of housing 12 to ventilate the latter and facilitate such heat dissipation. Any heat transmitted upwardly is dissipated through openings 143 in member 126 and through retainer bore 152, openings 186, the interior of cup-shaped member 184, and outwardly through aligned openings in end wall 166 and cap member 180. Outer liner 122 serves as a heat shield and aids in directing the heat upwardly through passage 134. Housing wall 16, which is spaced from liner 122, is virtually uneffected by the intense heat generated by oxygen candle 26, which heat is dissipated outwardly through perforated liner 120 and upwardly by convection through the open end of housing 12. Also, the suspension of cartridge 14 within housing 12 at only two points by means

of studs **50** and **60** significantly contributes to the dissipation of heat away from housing **12**. As a result, the temperature of housing shell **16** remains low and is harmless against human contact therewith. This is especially significant when it is realized that cannister **24** maintains a temperature of approximately 400° F. during normal combustion of the candle.

The size and the oxygen evolving duration of cartridge **14** can vary, as desired. Also, oxygen candle **26** can be of the multi-stage ignition type providing full flow operation at the mask within a predetermined minimal time limit and provding a minimum rate of relatively high oxygen flow for the first few minutes followed by a smooth transition to a minimum rate of reduced oxygen flow for the remainder of the oxygen evolving duration. However, once candle **26** is ignited, it will continue to burn until expended.

In order to replace a spent cartridge **14** with a fresh one and to reset actuating assembly **144** for subsequent operation, cover **20** is removed and casing **140** is threaded out of retainer member **126**, carrying with it the entire ignition actuating assembly **146** to expose cartridge **14**. To facilitate the removal of a spent cartridge **14**, a tool **234** (FIG. 1) is releasably mounted in cover **20** as by means of a spring clip **236** fixed to fastener **230**.

Tool **234** comprises a strip **236** of metal reversely bent to form a loop **238** which serves as a handle for tool **234**. The reversely bent portion is spaced from the main strip portion by a spacer element **240** and is connected thereto by means of a suitable fastener **242**. The distal end of tool **234** is bent inwardly as at **244** and is bifurcated to provide spaced fingers **246** (only one of which is shown in FIG. 1) adapted to engage about body portion **68** of stud **60** below flange **70**. The angular bend **244** in tool **234** facilitates the entry of fingers **246** into opening **138** of retainer member **126** and the positioning thereof about stud **60** so as to apply upward pressure against flange **70** and raise cartridge **14** out of housing **12**. A fresh cartridge **14** can then be placed in housing **12** with tubular body **58** of stud **50** inserted within fitting **90** until shoulder **56** abuts against face **96** of fitting **90**. Thus, cartridge **14** is correctly positioned within housing **12** in readiness to receive actuating assembly **144**, which must be reset and cocked prior to assembly with cartridge **14**.

When actuating assembly **144** is detached from retainer member **126**, the various parts thereof are in the relative positions shown in FIG. 6. In order to reset or cock actuating assembly **144**, firing pin **154** is forced within actuator body **150** against the bias of spring **188**. When groove **190** is aligned with openings **170** in body **150**, balls **172** will be shifted inwardly by cam surface **201** of actuator sleeve **196** under the influence of spring **204**. Actuator sleeve **196** is then free to move upwardly relative to body **150** under the urging of spring **204**, carrying safety lock shaft **212** therewith. The various parts of actuating assembly **144** are then in the relative positions illustrated in FIG. 4 and firing pin **154** is held in its cocked position by means of balls **172**. Lock shaft **212** is shifted axially to lock actuating sleeve **196** in its raised position to prevent inadvertent release of firing pin **154**. Casing **140**, together with actuating assembly **146** in its cocked position, can then be assembled to retainer member **126** and cartridge **14** in a manner hereinbefore described.

FIG. 2 illustrates another form of an oxygen generator assembly of this invention which is similar to the form of the invention first described except that the housing, identified by numeral **12'**, is made larger to contain two cartridges **14**, which may be serially activated to produce a substantially continuous flow of oxygen when one of the cartridges **14** is spent. As shown in FIG. 2, manifold **76'** is substantially longer than manifold **76** to receive the output of both cartridges **14**. Retainer member **126'** also is different in construction in order to accommodate both cartridges **14** and their actuating assemblies **144**. However, each cartridge **14** is provided with its own inner and outer liners, **120** and **122**, respectively, in a construction similar to that first described. FIG. 2 also illustrates the use of a fastener **250** fixed to member **126'** for securing the other end of tether strap **226** thereto preventing complete detachment of cover **20** and possible misplacement thereof. The other elements shown in FIG. 2 are identical to those described in connection with the first form of the invention and are identified by similar reference characters.

An advantage residing in the second form of this invention is that the second cartridge can be ignited just prior to the depletion of the first to provide a continuous flow of oxygen to the user, if required. While the second cartridge is being consumed, the first can be replaced by still another cartridge to insure a continuous supply, when needed. Of course, the present invention contemplates the use of any number of cartridges **14** suitably mounted in a common housing, as desired.

From the foregoing, it is apparent that the objects of the present invention have been fully accomplished. As a result of this invention, an oxygen generator is mounted within a housing in spaced relation thereto and is provided with means for dissipating the heat released from the burning generator by convection away from the housing to enable the latter to be safely handled by the user during combustion. An easily cocked, manually operable actuating mechanism is releasably mounted in the housing in spaced relation to the generator to prevent overheating of the actuator.

Certain embodiments of this invention having been described and illustrated in detail, it is to be understood that this has been done by way of illustration only.

What is claimed is:

1. A gas generator assembly comprising: a housing comprising a shell, an end wall and an open end, a cover adapted to close said open end of said housing shell, a retainer member mounted in said housing adjacent said open end, a cartridge containing an oxygen-evolving candle therein mounted within said housing in spaced relation from said shell, said cartridge having means affixed to and extending from the opposite ends thereof for suspending said cartridge in a fixed position between said end wall and said retainer in spaced relation therefrom to prevent direct transmission of heat between said cartridge and said retainer member, and actuating means for igniting said candle, said actuating means being mounted on said retainer in spaced relation from said cartridge to prevent direct transmission of heat between said candle and said actuating means.

2. A gas generator assembly according to claim **1** wherein said suspending means comprises hollow studs fixed to the opposite ends of said cartridge and defining passages therein.

3. A gas generator assembly according to claim **1** wherein said cartridge is a self-contained unit separably insertable in and removable from said housing.

4. A gas generator assembly according to claim **1** wherein said actuating means comprises a spring-loaded firing pin movable from a cocked position to a firing position, means retaining said firing pin in said cocked position, and means releasing said retaining means enabling said firing pin to move to said firing position.

5. A gas generator assembly according to claim **4** wherein said actuating means includes means for locking said releasing means to prevent actuation of said firing pin into said firing position.

6. A housing for a gas generator comprising: an elongated shell having an end wall and an open end, said end wall having a plurality of openings therethrough forming vent passages, a cover adapted to close said open end, means removably securing at least one gas generator cartridge within said shell in spaced relation thereto, spaced inner and outer liners interposed between said cartridge and said shell in spaced relation from said cartridge and said shell, respectively, said inner liner being provided with a multiplicity of openings for dissipating heat gen-

erated by the combustion of said cartridge, said inner and outer liners defining a passage for the dissipation of said heat, and said securing means having openings therein placing said passage in communication with the ambient atmosphere.

7. A housing according to claim 6 including means connecting said cover to said housing upon removal of said cover from said open end of said shell.

8. A housing according to claim 6 wherein said cover is provided with means for carrying a cartridge removing tool.

9. A housing according to claim 6 including manifold means interposed between said end wall and said cartridge and having oxygen passage means connecting said cartridge to a delivery tube.

10. A housing according to claim 9 wherein said housing contains two gas generator cartridges, each surrounded by a pair of said liners, said manifold connecting said cartridges to a common delivery tube.

11. A gas generator assembly comprising: a housing comprising a shell, an end wall and an open end, a cover adapted to close said open end of said housing shell, a retainer member mounted in said housing adjacent said open end, a cartridge containing an oxygen-evolving candle therein mounted within said housing in spaced relation from said shell, said cartridge having means at the opposite ends thereof for suspending said cartridge between said end wall and said retainer in spaced relation therefrom, actuating means mounted on said retainer in spaced relation from said cartridge for igniting said candle, said suspending means comprising hollow studs fixed to the opposite ends of said cartridge as an integral part thereof, and a manifold fixed to said housing end wall and interposed between said housing end wall and the inner end of said cartridge, said manifold having means for receiving one of said cartridge studs in a slip fit engagement for properly positioning said cartridge in the desired orientation.

12. A gas generator assembly according to claim 11 wherein said manifold is provided with passage means establishing communication between said cartridge and a delivery tube leading to a face mask.

13. A gas generator assembly comprising: a housing comprising a shell, an end wall and an open end, a cover adapted to close said open end of said housing shell, a retainer member mounted in said housing adjacent said open end, a cartridge containing an oxygen-evolving candle therein mounted within said housing in spaced relation from said shell, said cartridge having means at the opposite ends thereof for suspending said cartridge between said end wall and said retainer in spaced relation therefrom, actuating means mounted on said retainer in spaced relation from said cartridge for igniting said candle, and a pair of spaced inner and outer liners interposed between said cartridge and said shell in spaced relation therefrom.

14. A gas generator assembly according to claim 13 wherein said inner liner is perforated forming vent passages therethrough for dissipating heat generated by the combustion of said candle.

15. A gas generator according to claim 13 wherein said outer liner comprises a shield means preventing transmission of heat to said housing shell.

16. A gas generator assembly comprising: a housing comprising a shell, an end wall and an open end, a cover adapted to close said open end of said housing shell, a retainer member mounted in said housing adjacent said open end, a cartridge containing an oxygen-evolving candle therein mounted within said housing in spaced relation from said shell, said cartridge having means at the opposite ends thereof for suspending said cartridge between said end wall and said retainer in spaced relation therefrom, actuating means mounted on said retainer in spaced relation from said cartridge for igniting said candle, said suspending means comprising hollow studs fixed to the opposite ends of said cartridge as an integral part thereof, said actuating means comprising a casing releasably secured in said housing retainer member, and a retainer mounted in said casing for slip fitted engagement about one of said cartridge studs.

References Cited

UNITED STATES PATENTS

2,114,142	4/1938	Hloch	23—281
3,385,672	5/1968	McGoff et al.	23—281
3,443,907	5/1969	Marsteller	23—281
3,565,068	2/1971	Bickford	23—281 X
3,580,250	5/1971	Oroza	23—281 X
3,607,122	9/1971	Hwaschinsky	23—281
3,620,683	11/1971	Hwaschinsky et al.	23—281

FOREIGN PATENTS

498,449	12/1953	Canada	23—281
601,295	5/1948	Great Britain	23—281
834,422	5/1956	Great Britain	23—281

BARRY S. RICHMAN, Primary Examiner

U.S. Cl. X.R.

128—142, 142.3, 203